

# designing educational game android to improve mathematical unsderstanding ability on fraction

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**Submission date:** 23-Mar-2020 02:58PM (UTC+0700)

**Submission ID:** 1280263784

**File name:** to\_improve\_mathematical\_unsderstanding\_ability\_on\_fraction.docx (2.39M)

**Word count:** 3185


**Character count:** 16633

# Designing educational game android to improve mathematical understanding ability on fraction

**Abstract.** In the modern era, a lot of smartphones that have been created to make it easier for the people in their daily activities. The more people using the smartphone, provide the opportunity to this technology can be used to support action in the education sector one of these games education. Game education specially designed to give the learning to the users and give them the motivation to play the game to increase the ability of students understanding. The purpose of this research is to produce game education in junior high school students are valid and practical well as to expand the knowledge of students to see after using these of media. Research methods that used in this research are research of development by model ADDIE was (analysis, design, development, implementation, and evaluation). The instrument used is sheets interview to know student learning difficulties, validation sheets, sheets practically, question test (pretest and posttest). According to the discussions of students said that it takes the media in learning that students not bored in learning. Results of this educational game data analysis are valid, practical and can improve the ability of student's mathematical understanding related to fraction material with sufficient improvement interpretation.

## 1. Introduction

Mathematics is considered one of the most challenging lessons for students. At present, not a few students who view mathematics as an annoying and frightening subject [1]. Moreover, if the learning uses conventional models or those that have often been used such as listening and taking notes. In the implementation of classroom learning students should not only memorise material, but students also need to know what meaning contained in the material concept. [1] Having comprehension skills is very important for students to facilitate mathematics learning, and when they solve problems in daily life. They [3]. Indicators of the ability of mathematical understanding taken in this study according to the National Council of Teachers of Mathematics (NCTM), namely: define concepts verbally and in writing; identify the characteristics of an idea; change a form of representation to another way; recognise various meanings and interpretations of concepts [4]. As in fraction material, one of the learning objectives of the fraction number is that students can solve problems related to fraction counting operations. But based on research in the field stated that the mathematical understanding of class VII students on the material operating fractions is still lacking. Based on the results of preliminary trials and interviews of grade VII mathematics teachers who showed the results of the average learning completeness only reached 30%, thus the level of mastery of the material was still below 75%. Therefore it is necessary to improve learning until the student's score reaches a minimum of 75. If learning difficulties in the fraction material did not immediately anticipate, it will lead to learning anxiety and influence the opportunities for student involvement in learning mathematics later [5]. One of the causes of student learning difficulties in fraction material is a method in boring learning. The use of media can increase student interest and can improve students' understanding of mathematical concepts so that mathematics learning achievements on fraction also increase [6].

 Learning media using a technology called mobile learning (m-learning) is a digital-based learning device (PDA), tab, iPhone, or cellphone (smartphone) as the primary device [7]. In this modern era, many smartphones have been created to make it easier for humans to move. Smartphones are no longer a luxury item that can only be owned by the upper class but can also be owned by the middle to lower grade. Android smartphones used because, in addition to prices that are relatively affordable, the Android operating system can be developed openly or open source that allows users to create their applications according to needs freely [8]. As we have seen, the ease of getting a smartphone causes

students or adolescents under the age of 20 to use smartphones in the learning process at home and school. The game is one of the most popular services on smartphone devices. But the game is still considered an entertaining and fun service, so we need to change this mindset to be more useful by utilising developing technology. So that the game is not only used as a fun service but also a service that provides learning for its players [8].

Interactive media is growing. There are many types of media that teachers can develop. Several interactions applied to designing learning media, such as games [9]. Educational games are games in which there are elements of education and learning. In the mathematics education game, mathematical learning content is inserted in the form of material, examples of questions, and questions so that students actively experience, understand the game, and solve problems that are in it [10]. The use of educational games in smartphone devices makes it easier for students to access learning materials and practical application [11]. RPG (Role Play Game) is the latest version of RPG Maker to make RPG genre games. RPG Maker MV (trial) is good for developing games on various platforms, for example, PCs/laptops, Android smartphones and even websites [8]. RPG is a game where players can control one character as the main character in a story. As the main character, players can explore, interact, and play a full role in the story. The purpose of this study was to analyze student learning difficulties, making learning media in the form of a valid and practical RPG educational game, and to find out the improvement of students' comprehension skills in fraction material after using educational game media.

## 2. Methods

This research is R & D (Research and Development) or research and development. This research is intended to produce a specific product and test the effectiveness of the product [13]. The development model in this study uses ADDIE (analysis, design, development, implementation, and evaluation) [12, 14]. The ADDIE development model chosen because it is one of the most widely used models for developing useful products [14]. The material and questions in this game are about fractions. The article taught in junior high school.

The initial stage of this research is the analysis phase, which is conducting interviews with teachers and students. This interview was conducted to determine the needs of students in the form of problems and characteristics of student learning [15]. Also, at this stage, analysis of what material included in this media is made possible to be presented in the form of educational games. At the design or design stage is the stage of making storyboards, preparation of material texts and questions that loaded in the game. This game made by game maker software that is MV RPG. In the development stage, several stages of development carried out, namely the validation of educational games by two media experts (lecturers), and two material experts (lecturers & mathematics subject teachers). Modified media validation sheets from Akbar are shown in Table 1 [19].

**Table 1.** Media Validation Question

Aspects	Indicators
Relevance	<ol style="list-style-type: none"> <li>1. Material relevant to the competence that must be mastered by students.</li> <li>2. The game contains indicators of learning mathematics in the fraction number material by the predetermined basic competences.</li> <li>3. Problems in the game relevant to the material presented and the competencies that must mastered students.</li> <li>4. Explanation examples are relevant to competencies that must be controlled by students.</li> </ol>
Systematics dish	<ol style="list-style-type: none"> <li>1. The material presented is coherent.</li> <li>2. Material content is easy to understand.</li> </ol>

	3. The use of language that is clear and easy to understand.
Conformity with demand	<ol style="list-style-type: none"> <li>1. Encourage curiosity from students.</li> <li>2. Encourage the interaction between students with the games presented.</li> </ol>
Game design	<ol style="list-style-type: none"> <li>1. The appearance of each map (location) is interesting</li> <li>2. Transfer between maps (location) is clear (does not make confusion).</li> <li>3. Characters in interesting games.</li> <li>4. The text in the game is bright and legible</li> <li>5. Image and audio on the game are clear</li> <li>6. The storyline or story scenario in the game is exciting and understandable</li> <li>7. There are no bugs in the game</li> <li>8. There are clear goals in the game.</li> <li>9. Information and commands in the game are notified</li> <li>10. Games run on PC / laptops and Android phones</li> </ol>

Also, it also tested the practicality of users by nine respondents in which three students with high abilities, three students with moderate skills, and three students with low skills. The modified user practice sheet from Hamdunah shown in Table 2.

**Table 2.** User Practicality Questionnaire

Aspects	Indicators
Convenience	<ol style="list-style-type: none"> <li>1. Easy to understand.</li> <li>2. Information and commands in the game are easy to understand</li> <li>3. Games run on PC and Android.</li> </ol>
Language	<ol style="list-style-type: none"> <li>1. Clear and easy to understand</li> <li>2. Does not contain confusing sentences</li> <li>3. The story scenario is easy to understand</li> </ol>
Game contents	<ol style="list-style-type: none"> <li>1. Material presented clearly.</li> <li>2. Material and questions are clear and easy to understand.</li> <li>3. The images displayed on the game are clear.</li> <li>4. Switching between clear maps (does not create confusion)</li> <li>5. The interaction between the game and the user</li> <li>6. Interesting game display</li> </ol>
Satisfaction	<ol style="list-style-type: none"> <li>1. Feel happy learning math using games</li> <li>2. Increase the spirit</li> <li>3. Learn math easier</li> <li>4. Educate</li> </ol>

Furthermore, the implementation stage of this stage is the stage where the application that has designed, analysed, and built, then tested its feasibility to be operated accordingly according to its function and usefulness [15]. Evaluation is the final step of the ADDIE learning system design model. Assessment is a process carried out to provide value to the learning program. This evaluation aims to determine whether there is an increase in the ability of students' mathematical understanding of the fraction material [15].

### 3. Results and Discussion

#### 3.1. Stage Analysis

Problems and learning characteristics of students obtained from the results of interviews with mathematics teaching teachers and 30 students. The results of interviews with students stated that mathematics was a problematic lesson compared to other lessons. They also experienced difficulties when determining the results of operations in calculating fractions. Not much different from the results of interviews with teachers, the results of the interviews found that in general students still have many difficulties in learning fraction material due to a lack of understanding of the article, moreover learning is still teacher-centred, and rarely use appropriate learning media. Indicators of learning that used in the game by Core Competencies (KI) and predetermined Basic Competencies (KD) that is to explain and perform operations to calculate integers and fractions by utilising various operating properties.

#### 3.2. Design Phase

This game tells the story of a child who comes to the hermitage to demand martial arts to get four strengths namely the power of land, water, fire, and wind. To get the 4th power of the child must defeat the monster and master the operating material count on the fraction number and answer the practice questions that will be given by the characters encountered. Each answer the problem correctly will get the point to see the level of understanding of students. But if the child can't defeat the monster, then the game is over.

3.2.1. *Map Creation.* Map creation in the initial view using the Photoshop application to create the image design. As seen in Figure 1.



Figure 1. Initial display



Figure 2. Map 1 Padepokan

Map 1 describes the location of the fraction martial number pad; in this folder, there are two characters to be found. The following is the atmosphere of the hermitage as shown in Figure 2. Map 2 describes the location of the desert where it is level 1, and there are four characters that must be encountered. The following is the location of the desert as seen in Figure 3.





**Figure 3.** Level 1



**Figure 4.** Level 2

Map 3 describes the location of the sea where it is level 2, and there are four characters that must be encountered by the main character. The following is the location of the sea as shown in Figure 4. Map 4 is the location of the volcano where it is level 3, and there are three characters that must be encountered. The following is the location of the volcano as shown in Figure 5.



**Figure 5.** Level 3



**Figure 6.** Level 4

Map 5 describes the location of the wind empire where it is level 4, and there are three characters that must be encountered by the main character. The following is the location of the wind kingdom as seen in Figure 6. Map 6 is the final location where the main character will be notified of the level of understanding when answering practice questions about the fractional number count operation. Here is the area of the wind kingdom as shown in Figure 7.



**Figure 7.** Final

**3.2.2. Character Making.** The characters/characters that used in the game designed according to the wishes of the game maker. As seen in Figure 8.



**Figure 8.** Character making

The coding used are: (1) Show Text: used to display text, it used to display pro-logic text or conversations between characters; (2) Show Choices: used to present questions in the form of multiple choice questions; (3) Show Picture: used to view images in games; (4) Battle Processing: used to display battles in the game; (5) Transfer Player: used to move characters from one place to another.

**3.2.3. Deploy a Game.** After the game finished, the next thing to do is to deploy the game so that it can be played either on a PC / laptop or an Android smartphone. As seen in Figure 9.



**Figure 9.** Deployment

### **3.3 Development or Development Phase**

After designing the game in the previous stage, at this stage, it explained about how to operate the game and then displays the results of media validation and also the results of user practicality.

**3.3.1 Operation of the game.** The operation of Game of Fraction is very easy that only touches on the HP screen. The initial appearance and prologue of this games seen in Figure 10 and Figure 11.



Figure 10. Initial appearance



Figure 11. Prologue

Here are a few examples when the main character is given material and questions. Seen the main character gets the material in Figure 12. Here is a case when the main character is given a problem in the form of practice questions. There looks like in Figure 13.

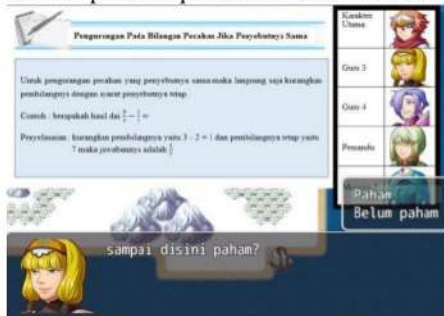


Figure 12. Giving Material



Figure 13. Giving Problem

In this game, there is a fight between the main character and the monster where if the main character loses then the adventure of the main character will end. Figure 14. will appear when the main character falls on his adventure. When the main character succeeds in completing his adventure, a display will appear as shown in Figure 15.



Figure 14. Main Figure Failed



Figure 15. Giving Problem



**3.3.2 Media Validation Results.** Media validation to 4 validators, including two validators as media experts, and two validators as material experts. The following are the results of media validation as shown in Table 3.

**Table 3.** Media Validation Results

Validator		Validation Criteria
4 Validator 1 and 2: Materials Expert	1 <sup>st</sup>	97,4 %
	2 <sup>nd</sup>	100 %
	3 <sup>rd</sup>	93,4 %
	4 <sup>th</sup>	97,4 %
		Media Expert, Validator 3 and 4:

**3.3.3 Practical User Results.** After conducting media validation, this study also conducted user practicality tests. The subject of the investigation is the user practicality test as many as nine students which consists of 3 students with high ability, three students with moderate abilities, and three students with low abilities. The following are the results of the user practicality shown in Table 4.

**Table 4.** User Practicality Results

Capability level	Evaluator	Percentage (%)	Average Capability level (%)
High	S-1	98.4	97.4
	S-2	96.9	
	S-3	96.9	
	S-4	93.8	
Moderate	S-5	95.3	94.8
	S-6	95.3	
	S-7	89.1	
Low	S-8	76.6	80.7
	S-9	93.8	

#### **3.4 Implementation Phase.**

The next stage is the stage of the trial (implement) at this stage the educational game media that has been declared feasible to be used in testing to students. This stage is the stage where the pretest and posttest conducted. This process is carried out on class VII Cirebon 14 Junior High School. The pretest conducted on August 9, 2018, the pretest conducted before the students were given material with educational games, and on August 14, learning was conducted using educational game design media, then after the teaching finished the student given a posttest question.

#### **3.5 Evaluation Phase**

The last stage is the evaluation stage, which is the stage of evaluating what students get after using the educational media game and knowing how effective the educational media game has made. Based on the calculations in the pre-test and post-test, there is a gain value obtained is 0.52 according to normalised gain criteria due to the medium category.

Android-based educational games are the final product of this study, in this game there are material, sample questions, and practice questions about fraction material, besides that there are various

challenges in this game to attract students to play this game. So if students fail in playing this game, students will try to play it again to solve the challenges in the game. In contrast to the pocketbook application developed by Saputra, Saputra developed a learning media in the form of a pocketbook application that can be installed using an Android-based smartphone [16]. The contents of the pocketbook application include material, videos and training. Educational games that have developed have similarities with Pocketbook regarding improving students' mathematical understanding skills. But the pocketbook is still lacking regarding attracting student interest because the pocketbook only displays interesting images but does not make students challenged to play the application again

Research on developing educational games was also carried out by Rohendi. In his research, developing horizontal multimedia counting learning [17]. Educational games that have developed in this study have in common with horizontal multimedia counting regarding improving students' mathematical understanding skills. But the use of these media can only be used through a computer, so the use of multimedia is less practical if used by students in learning.

Another study that developed android applications was a study by Astra [18]. That is, the use for ideal as simulations and target users is high school students. To install the application, the user must first install Adobe AIR on the smartphone, which is different from the application developed in this study. Educational game applications can directly installed without requiring additional applications first.

#### 4. Conclusion

Based on the results of the analysis of research data and discussion, the following conclusions can be drawn: firstly, the game media of education "Game of Fraction" on the material of logical fraction operations. It shown by an average percentage of 97.4% of the total value of the validator of media experts and material experts. Secondly, educational media game "Game of Fraction" on useful fraction operations material. It indicated by an average percentage of 91.10% of the total value of the overall practice of 9 students consisting of 3 students with high abilities, three students with moderate abilities, and three students with low abilities. Thirdly, educational game media "Game of Fraction" can improve student learning outcomes, where the average value of the initial test 45.13 increased to 76.93 by getting a normalised gain value of 0.52 and included in the common interpretation.

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